force, and the acceleration is in part lost. The center of this belt of strongest winds shifts over a zone seven degrees eleven minutes wide, the inclination of the plane of the equator to the plane of the ecliptic being one-half of this arc.

In temperate latitudes the oblique rays are not capable of producing so great an acceleration, and hence the spots of these latitudes have longer periods of revolution. The northerly and southerly components of the Earth's wind systems are also greater than on *Jupiter*. This condition is brought about by the decreased heat received by the latter planet, and his shorter period of axial revolution.

The motions of the atmosphere of *Jupiter* are, therefore, simpler than those upon the Earth. This is due to the fact that upon *Jupiter* solar energy acts upon a more homogeneous surface than is offered by the partly clouded and partly clear atmosphere of the Earth, and by its varying heat-appropriating surfaces of land and water.

TELEGRAPHIC ANNOUNCEMENTS OF ASTRONOMICAL DISCOVERIES, ETC., IN AMERICA.

By Edward S. Holden.

In 1871, Dr. C. H. F. Peters, Director of the Hamilton College Observatory, addressed a letter to the Secretary of the Smithsonian Institution asking that the Institution should act as a central-office for communicating discoveries of planets, comets, etc., by telegraph. Steps were immediately taken by Professor Henry to arrange for such a service, and from 1873 to 1883 it was carried out under the auspices of the Institution. Great pains was taken by Professor Henry and Professor Baird to obtain the opinions of astronomers as to the best form of message, etc.*

These telegrams were decidedly useful to American science, in spite of many annoying errors which arose from the fact that the Institution had then no astronomer to serve as editor. The telegrams from discoverers received by the Institution were very often wrongly worded, and there was no control. These tele-

* See *Report of Smithsonian Institution*, 1882, page 57.

grams were widely disseminated by Associated Press dispatches; and in a more detailed and scientific form by the circulars of the Boston Scientific Society, edited by Mr. JOHN RITCHIE, from 1879 onwards. Mr. RITCHIE and Dr. S. C. CHANDLER, in 1881, devised a special cipher-code for transmitting such telegrams, which was submitted to, but not accepted by, the Smithsonian Institution. During 1882 and 1883 arrangements were concluded between the Harvard College Observatory and the Smithsonian Institution which resulted in the transfer of the control of this useful service to the Observatory on the formal acceptance of its Director.*

Mr. RITCHIE was appointed to take charge of this service, and Dr. CHANDLER (then also connected with the H. C. O.) calculated comet orbits, ephemerides, etc., for quick transmission to other observatories. The transfer of the Bureau of Astronomical Telegraphy from the Smithsonian Institution to the Harvard College Observatory was in direct agreement with the settled policy of the former establishment to relinquish its own work to other responsible institutions so soon as the latter are willing and competent to undertake it.

The beneficial effect of the change was immediately felt. It was principally due to competent and alert editorship, and only partially to the new code, which, however, received its full share of credit.

An equally efficient service is now maintained at Kiel by Professor KRUEGER, who uses, I believe, a different code.

The code devised by Messrs. RITCHIE and CHANDLER was similar to the "Science Observer Code" (described below). Its word-book was, however, WORCESTER'S Comprehensive Dictionary — an unfortunate choice. Many of the Commercial Code books (with a few pages of additions), as SLATER'S Telegraphic Dictionary, for example, would have served the purpose better. The most important part of Messrs. RITCHIE and CHANDLER'S system was not the cipher-code itself, but the introduction of control-words suitable for detecting and correcting errors of transmission or of translation. This very practical device will always be a part of every subsequent code. Almost any code will suffice, if sufficient checks are applied. No single code will be equally convenient to astronomers of all nations. The English language, with its illogical pronunciations and spellings, will always contain

* *Report of the Smithsonian Institution*, 1883, page 33.

many puzzles to Europeans. With the object of improving the cipher-code (the fundamental principles and methods remaining the same), the Boston Scientific Society printed, in 1888, *The Science Observer Code*, prepared by Dr. S. C. CHANDLER and Mr. RITCHIE. The preface to this work gives an interesting account of its development from 1879 to 1888.

The code consists of four parts. Part I is an explanation of the principle of the code with detailed accounts and examples of its use, and Part I^{A} is the Number Code. The latter is printed on 200 quarto pages, in double columns, and the column is the unit. Each column is numbered (from 1 to 400) and each contains 100 words—40,000 words in all. Opening the book, at random, at column five, the last words of this column are:

80	Acodalar	90	Acollarado
81	Acodiciar	91	Acollarar
82	Acodillar	92	Accolerge
83	Acogedizo	93	Acollido
84	Acogeta	94	Acollonar
85	Acogido	95	Acology
86	Acogollar	96	Acolytes
87	Acogombrar	97	Acolythist
88	Acogotar	98	Acomendar
89	Acolcetra	99	Acometedor

Opening once more at column 240, we find the first words of this column to be:

0	Grouping	10	Groyne
1	Groups	11	Grozzer
2	Grouse	12	Grubaxe
3	Groveled	13	Grudge
4	Groveling	14	Grudgeful
5	Growlers	15	Grudgeth
6	Growlingly	16	Grudgingly
7	Growls	17	Gruffly
8	Growth	18	Gruffness
9	Growthead	19	Grugery

A Spanish or Italian telegrapher would be at home in the first set of words, but he could not pronounce the second set at all. It is not easy for an American telegrapher to even spell the first set, as we know by many experiences over the Mount Hamilton telephone wire. The selection of words from all languages has resulted in pleasing no one; for the *Science Observer Code* is, I

believe, not used in Europe, and its large proportion of long Spanish words is not welcome in America. It is probable that these were selected on account of the consistent rules of Spanish pronunciation. But when they are in the mouths of American telegraphers, they are pronounced by strange and novel American rules, and the practical result is that they are slowly spelled out, letter by letter. As very many of them consist of nine or ten letters, this is a wearisome process and it tends to introduce errors. In the selection of the words, care was taken that each one should differ from every other by at least two letters. This is, however, a difference which is chiefly effective *to the eye*. It is more practical to select cipher words which sound differently to the ear. A large number of the cipher messages are received and sent by telephone. I think every user of this code is more or less dissatisfied with the selection of its words, although all recognize the great merits of the general principles on which it is based.

The words of the first 200 pages are used as follows: *Acogedizo* stands for 583, *Grozzer* for 24,011, etc. There are forty thousand such words used to express the numbers 1 — 40,000. They occupy 200 pages. A much simpler method to express such numbers is to form *two* tables (printed on two pages only), and to make each cipher-word out of a prefix and an affix. Table I would give over 500 *prefixes*, each of three letters; as *Baf, Bak, Bal, ... Baz; Daf, Dak, Dal, ... Daz; Waf, Wak, Wal, ... Waz*, etc. Each one of these is numbered 1 — 500. In choosing such prefixes, it would be necessary to reject those likely to produce confusion to the ear. Thus *Bag* and *Bak*, *Bas* and *Baz* should not both occur in the cipher-code; initials G and J should not both be employed; terminals *am* and *an* should not both be included; and so on. Other similar precautions, familiar to users of cipher-codes, must be observed, so far as the resources of the language permit.

Table II would give 99 *affixes*, each of five letters, as *— aside, — aglee, — omous, — ulate*, etc. These would be numbered 1 — 99. Any number of five figures, less than 50,000, can be made up of a cipher-word (always of eight letters) composed of any prefix *plus* any affix; as *Bafomous, Dakaside, Walulate*, etc. This is pure jargon, of course; but it is no worse than the quotations just given from the *Science Observer Code*. No English-speaking telegrapher will have any trouble with it. A cipher-code is necessarily a jargon. If its words are chosen

according to a system which is designed to avoid the particular errors which arise in the actual practice of telegraphy, such a jargon is preferable to one selected from ordinary dictionaries, especially from foreign dictionaries, which are arranged for quite another purpose and on very different principles. In any event the cipher-code should be as short as possible, on merely practlical grounds. A saving of 99 *per cent.* is worth making.

In order to show that a code of two pages is practicable and can take the place of the much longer code of the *Science Observer*, I propose to write such a one out in full at a future date—not, however, with any idea that it should now replace the system familiar to Americans, but simply to illustrate the principle to be followed in such codes.

Part II of the *Science Observer Code* is a "Phrase-Code." The arbitrary cipher-word stands in one column, and opposite it is the corresponding phrase — thus "Uglily" stands for "June 16"; "Unlawful" for "These are elliptic elements," etc. Part III comprises a few necessary tables. My own opinion is that Part II of the *Science Observer Code* contains too many rather than too few arbitrary symbols. It is always safer to transmit a message, which has to be handled by rather ignorant telegraphers, in plain English than in cipher. This was well illustrated in the famous cipher-dispatches of the Presidential campaign of 1876 (the keys to which I was among the first to detect)*.

The cipher used in most of these political dispatches was an excellent one, but the messages were mangled beyond recognition in many cases. The same lesson (to use plain English when it is possible) results from the experience of all army and navy officers concerned in such business. The cost of English telegrams is somewhat greater than that of the corresponding cipher-messages, but cost is a very secondary matter compared with freedom from error. The control-words of the *Science Observer Code* are extremely valuable in this regard.

The proposal to use a cipher-code for the transmission of important astronomical news, and the idea of introducing control-words to insure their accuracy, are due to Messrs. CHANDLER and RITCHIE. Their code has already rendered material benefit to astronomy. As the service is now conducted, astronomers are

* *See* my Report of 1879, February 21, to the Chairman of the Select Committee on Alleged Frauds in the Presidential Election of 1876, etc., and also, *The International Review* (N. Y.) for April, 1879, page 405.

sure of receiving early warnings of the appearance of a new comet, etc., and orbits and ephemerides can now be quickly computed and distributed. To any one who recollects the state of such matters previous to 1873, the improvement is most striking, and it is almost entirely due to the original suggestion of Dr. PETERS, to its prompt adoption by the Smithsonian Institution, and to the subsequent devices and able editorship of Messrs. CHANDLER and RITCHIE.*

ASTRONOMICAL OBSERVATIONS.

Made by TORVALD KÖHL, at Odder, Denmark, in the years 1894–95.

VARIABLE STARS.

Z Cygni.

1894.

January	1:	Z < e.	August	25:	< d.
	12:	< e.	September	1:	almost = e.
February	1:	invisible.		6:	< e.
	13:	invisible.		23:	id.
March	25:	a little < e.		29:	id.
April	6:	> e. / < d.	October	18:	invisible.
	8:	almost = d.		26:	id.
	9:	id.	November	10:	id.
	24:	= b. / a little < a.		16:	id.
	30:	= a.		22:	id.
May	24:	> a. / < 26.		30:	id.
June	3:	id.	December	12:	id.
July	29:	perhaps a little < d.		14:	id.
				16:	< e.
				30:	= e.

* European telegrams of the sort were formerly distributed by the Imperial Academy of Sciences of Vienna, according to a code devised by Professor KARLINSKI, of Cracow, in 1865. (*Ast. Nach*, Vol. LXV, col. 31; *ibid*, No. 1785.) The service was much neglected, as may be seen by the history of the new star discovered by SCHMIDT in 1876. It was of the utmost importance that this star should be observed at once. Accordingly, Dr. SCHMIDT notified Vienna on November 24th by telegraph. The first account of the discovery was printed by the *Astronomische Nachrichten* on December 23d (a month late). The first news reached Berlin on December 3d, and so on. Half the astronomical energy of Europe was wasted for lack of a little administrative ability exerted according to an intelligent system.